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A NEW HYBRID MODEL FOR ALL-SOLID-STATE BATTERIES

K. Becker-Steinberger*[1,2], S. Schardt[2,3], A. Latz[1,2,4]

[1] Institute of Engineering Thermodynamics, German Aerospace Center, Pfaffenwaldring 38-40, 70569 Stuttgart, Germany {Katharina.Becker-Steinberger, Arnulf.Latz}@dlr.de

[2] Helmholtz Institute Ulm for Electrochemical Energy Storage, Helmholtzstrasse 11, 89081 Ulm, Germany

[3] Karlsruhe Institute of Technology, Hermann-von Helmholtz Platz 1, 76344 Eggenstein-Leopoldshafen, Germany, Simon.Schardt@kit.edu

[4] Institute of Electrochemistry, University of Ulm, Helmholtzstrasse 11, 89081 Ulm, Germany

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In recent years, solid electrolytes (SEs) have experienced a growing interest as potential future components of safe next-generation high voltage batteries. The major bottleneck responsible for the present limitations of all-solid-state battery (ASSB) cells are the high interfacial resistances. Reasons for the large charge transfer resistances are still subject to scientific discussion. To improve ASSBs, fundamental knowledge of the underlying interfacial processes is essential. In this contribution, we explore the processes in ASSB cells by continuum modelling and numerical simulations. To this end, the rigorously derived transport model for SEs [1] is extended to ASSBs. Space charge layer (SCL) formation and charge transport in the SE is described by a generalized drift-diffusion-Poisson system. The electric SCLs in the electrodes are approximated giving rise to effective interfaces and respective conditions coupling the electrodes to the SE. The charge transfer at the electrified electrode-SE interface given by a defect reaction mechanism is modelled via a Butler-Volmer like approach [2]. The resulting hybrid model for a complete ASSB cell resolves the ionic SCL and couples them to intercalation electrodes by taking into account the effects of the electric SCLs without spatial resolution of the latter. It is used to simulate cyclic voltammetry and impedance for ASSBs. The computational results are compared to experiments. The effective interface approach allows us to study and identify the individual contributions of the electrochemical and the electro-quasi-statical interface processes separately within a continuum model.

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